

## **Current and Future Data Streams from Meteostat Geostationary Satellites for Solar Energy Applications**

### **Detlev Heinemann**

Department of Energy and Semiconductor Research, Faculty of Physics  
University of Oldenburg, D-26111 Oldenburg, Germany  
Phone/Fax +49-441-798-3543/3326, E-mail [dehe@ehf.uni-oldenburg.de](mailto:dehe@ehf.uni-oldenburg.de)

### **Hans Georg Beyer**

Department of Electrical Engineering  
University of Applied Sciences (FH) Magdeburg, D-39104 Magdeburg, Germany  
Phone/Fax +49-391-16499/16126,  
E-mail [hans-georg.beyer@elektrotechnik.fh-magdeburg.de](mailto:hans-georg.beyer@elektrotechnik.fh-magdeburg.de)

Data from the geostationary satellite Meteosat have been widely used for the derivation of solar surface irradiance for different kinds of applications.

However, a limitation has been the restriction to only two useful spectral broadband radiometer channels (0.44-0.96  $\mu\text{m}$ , 10.7-12.5  $\mu\text{m}$ ). This does not allow for the extraction of specific information of cloud properties affecting the downward radiant flux. Due to this limitation statistical algorithms currently perform with equal quality as compared to more sophisticated radiative transfer based techniques.

This situation will change significantly with the new Meteosat 2nd Generation (MSG) satellites the first of which will start its operation in late 2000. Main features

of this new satellite are completely revised radiometer instruments with 12 narrow-band channels which allow for a much more detailed identification of atmospheric parameters. This holds especially for the cloud radiative characteristics. In addition, temporal and spatial resolutions are both enhanced by a factor two.

The presentation will give a brief overview of the present Meteosat generation and will focus on a description of the new MSG satellite regarding its technical improvements and is enhanced set of products.

The potential benefits of this satellite for improving the satellite-based algorithms will be discussed. Finally, the envisaged access to these data streams for the solar energy community is mentioned.

# Current and Future Data Streams from Meteosat Geostationary Satellites for Solar Energy Applications

**Detlev Heinemann**

Carl von Ossietzky University Oldenburg  
Faculty of Physics

**Hans Georg Beyer**

University of Applied Science (FH) Magdeburg  
Department of Electrical Engineering

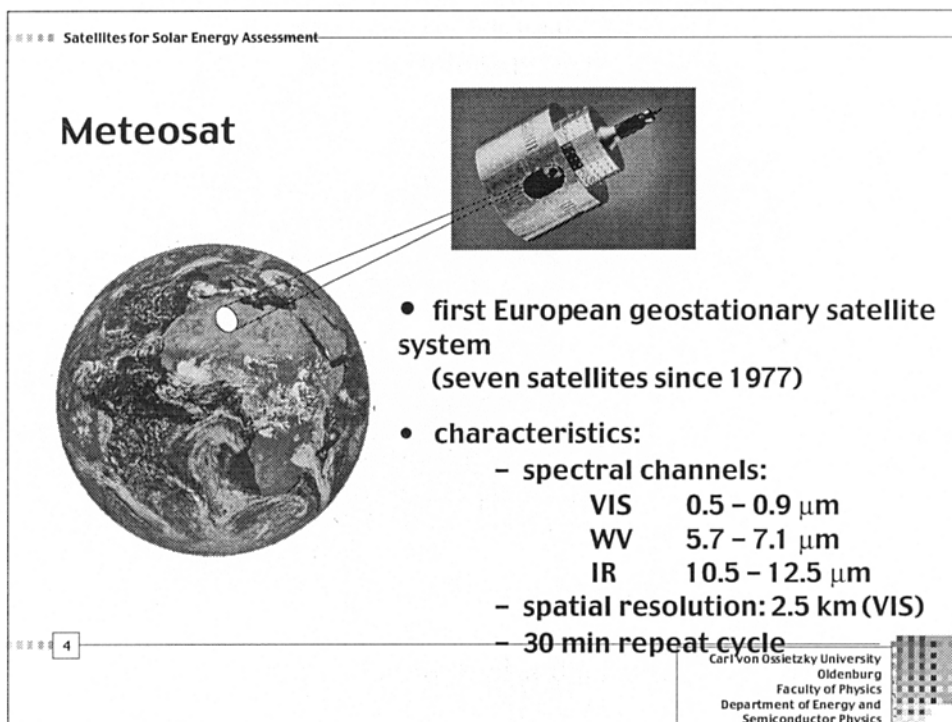
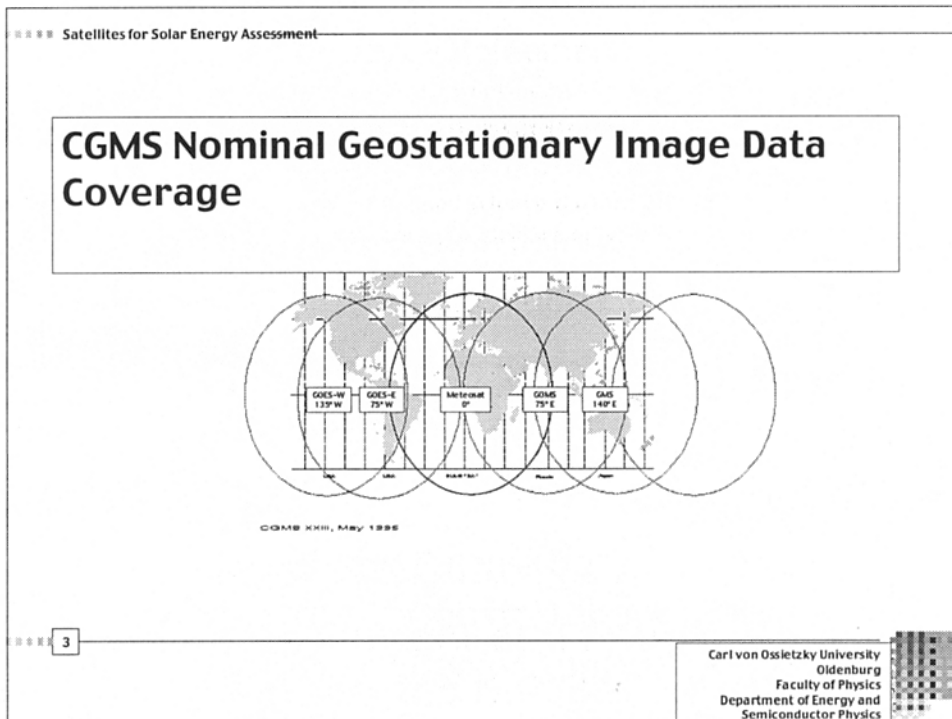


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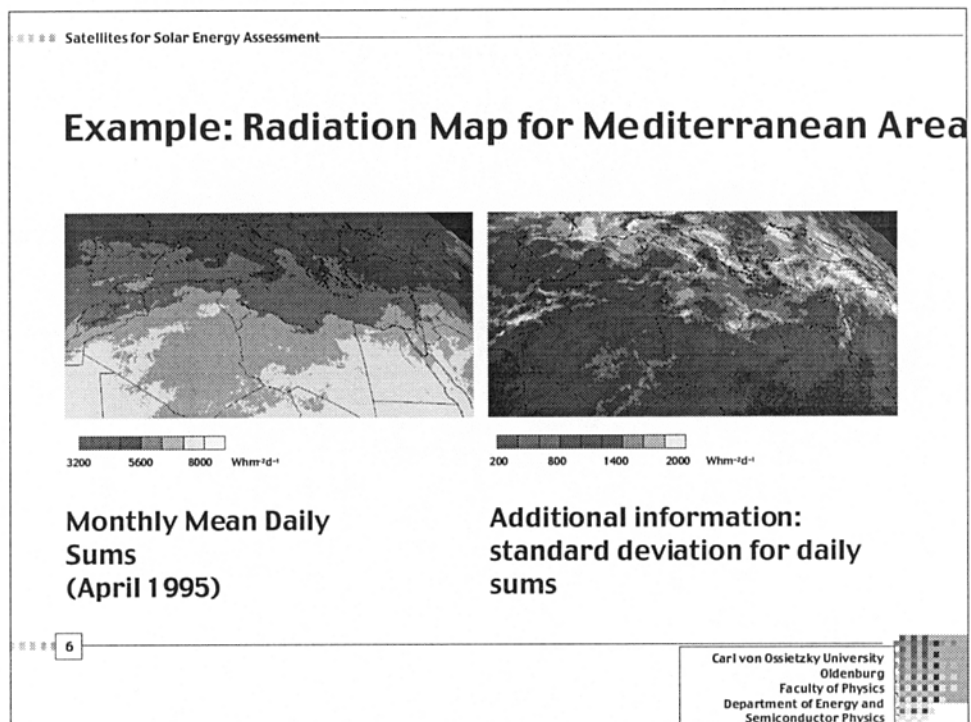
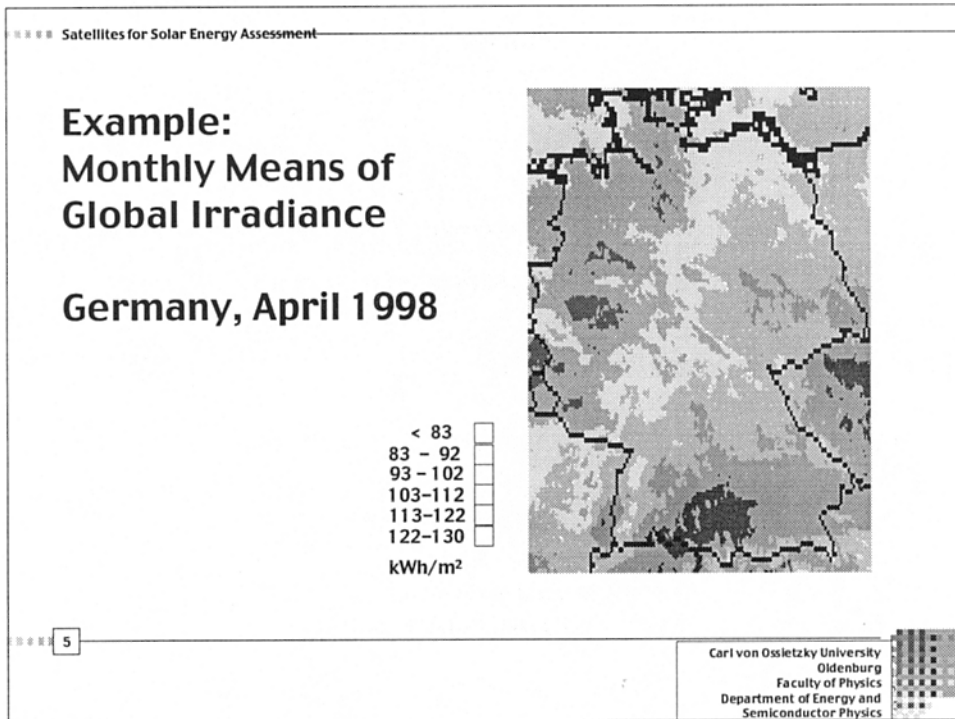
- Current Situation: Meteosat Operational Programme (MOP)
- Next Generation: Meteosat Second Generation (MSG)
- Data Access
- Potential Benefits for Surface Solar Energy Assessment
- Summary



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## Meteosat Second Generation Programme

### Major Improvements

- SEVIRI imager with 12 spectral channels
- 15 minute cycling of imaging
- 1 km horizontal image resolution for the HRV channel
- Geostationary Earth Radiation Budget (GERB) instrument
- all-digital data transmission
- nominal lifetime of 7 years
- enhanced set of products

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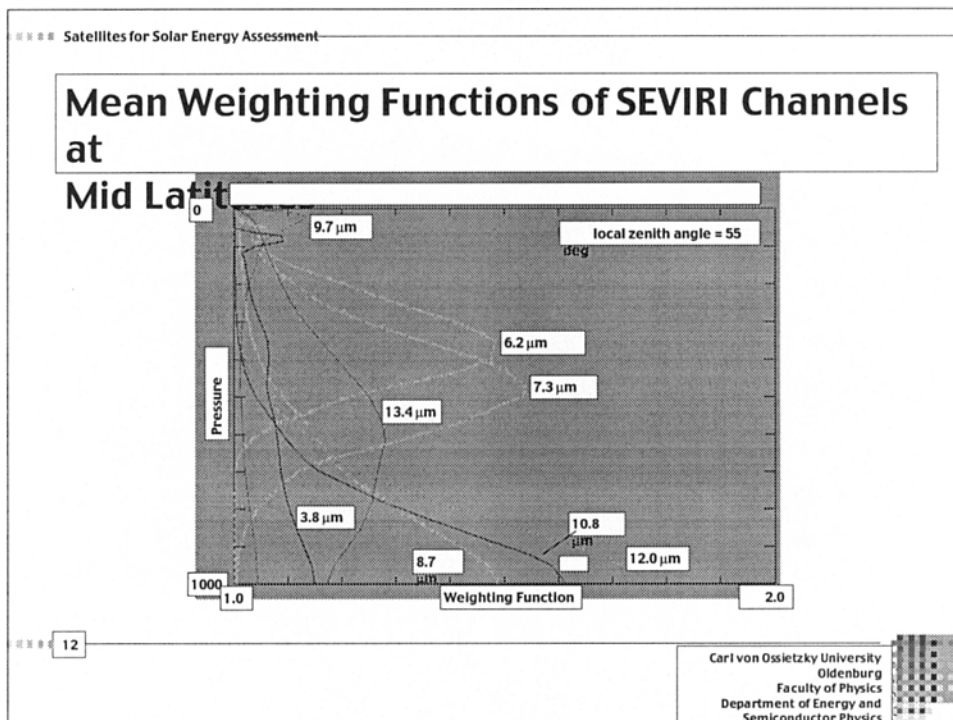
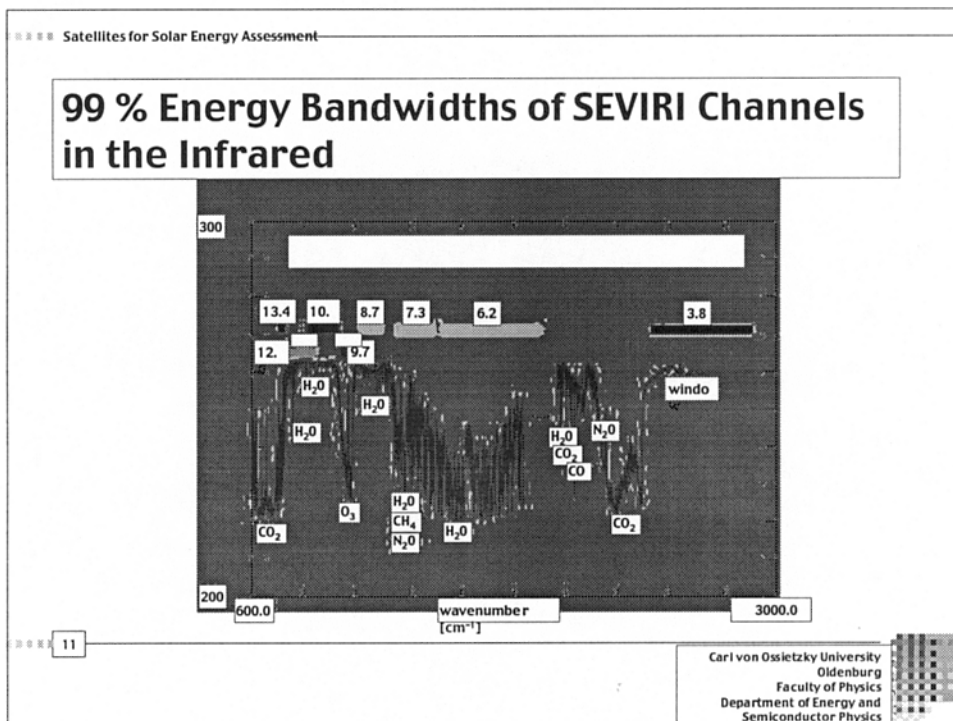
## Meteosat Resolution

	1st Generation (MOP)	2nd Generation (MSG)
Radiometric	8 bit	10 bit
Spatial	2.5 km	1 km
Temporal	30 min	15 min
Spectral	3 channels	12 channels

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## MSG Scan Modes

The diagram illustrates the MSG Scan Modes. It shows a map of the Earth with a central vertical strip labeled 'European Area'. To the left of this strip is a box labeled 'HRV Dissemination Area'. To the right, there are two boxes labeled 'Area "N"' (top) and 'Area "S"' (bottom). A box labeled 'HRV Scan Area' is located at the bottom of the central strip. The map is overlaid with a grid of scan lines.

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## MSG Data Coverage

The slide displays three satellite images. The first image on the left is a full-disk view of the Earth, labeled 'All Channels except HRV'. The second and third images on the right show a partial view of the Earth, labeled 'Nominal and Alternative HRV Coverage'. The second image shows a vertical strip of coverage, while the third image shows a more complex, L-shaped coverage pattern.

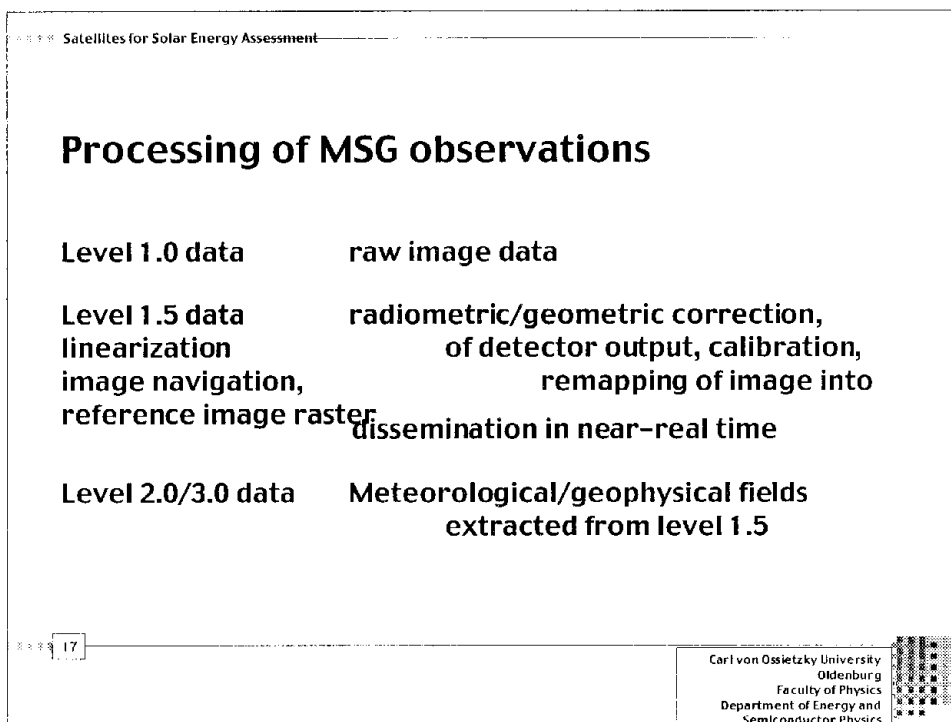
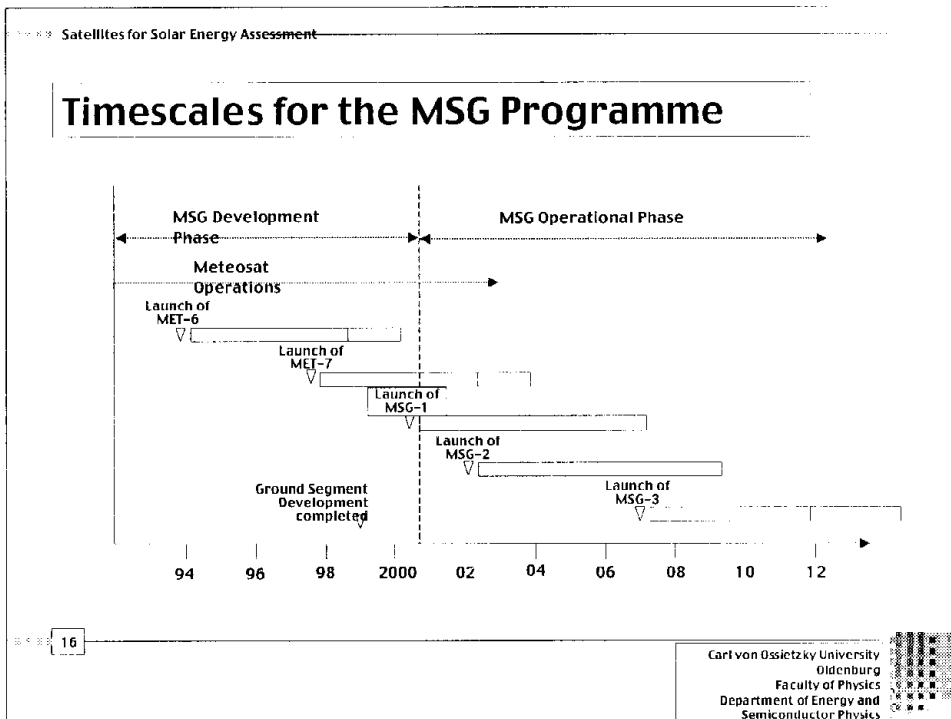
All Channels except HRV

Nominal and Alternative HRV Coverage

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## MSG Archive and Retrieval Facility

### Data Access by users from archive

- various formats (level 1.0, level 1.5, ..)
- various media (electronic transfer, CD-ROM, photographic images)
- regular or on-off basis
- Usually free of charge for research projects and educational use
- Access to real time HRI data is granted by national meteorological services

78 Data policy for HRI data is still under discussion within EUMETSAT

## Problems

- Uncertainties in atmospheric and surface parameters
- Clouds: characterization, inhomogeneity
- Sensor calibration
- Different space and time scales of satellite and surface data



Retrieval of direct/diffuse components

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## Calibration of VIS/NIR channels

- pre-launch characterization
- calibration campaign after first MSG launch (aircraft)
  - goal: 5 % absolute accuracy
- radiative transfer modelling of outgoing radiances
- monitoring of long-term degradation of optical elements
- satellite intercalibration
- vicarious calibration: selection of target areas
- expected overall accuracy 5–10 %

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Department of Energy and  
Semiconductor Physics

## Cloud Processing

- objectives: identification of cloud type and phase; retrieval of cloud parameters
- main products of MSG: cloud flag /scene analysis), cloud type (cloud analysis), cloud top temperature and height
- first analysis (10.8  $\mu\text{m}$ , 0.6/0.8  $\mu\text{m}$ ): albedo, brightness temperature
- fine analysis of spectral behaviour: low/high clouds (3.7  $\mu\text{m}$ ), cirrus identification (10.8  $\mu\text{m}$  vs 12.0  $\mu\text{m}$ ), snow/ice covered land surface (0.6  $\mu\text{m}$ ), sunglint (3.7  $\mu\text{m}$ )
- problem to solve: selection of adequate combination of spectral channels to separate cloud type characteristics; influenced by atmospheric conditions and sun-satellite geometry

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## Use of Radiative Transfer Models

- on-line generation of meteorological products
- off-line applications (e.g. climate studies)
- sensor calibration
- evaluation of specific parameterizations

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## Benefits for Surface Solar Energy Assessment

- improved cloud detection/classification
- scale effects
  - fractional clouds
  - time/space mismatch between surface and satellite data
- calibrated VIS signals
- real-time products (using ancillary information, NWP output)

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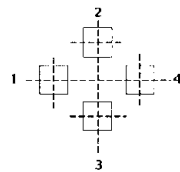
## Summary

- Promising new capabilities of next satellite generation
- Additional information, higher accuracy
- Combination satellite data / RTMs
- Inference of small-scale irradiance structure by joint use of satellite and ground data

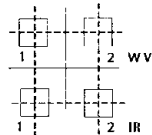
## Meteosat Pixel Size

### 1st Generation (MOP)

2.25 km (Visible)

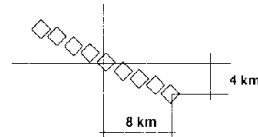


5 km (IR + WV)

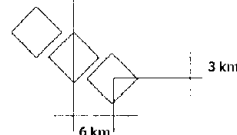


### 2nd Generation (MSG)

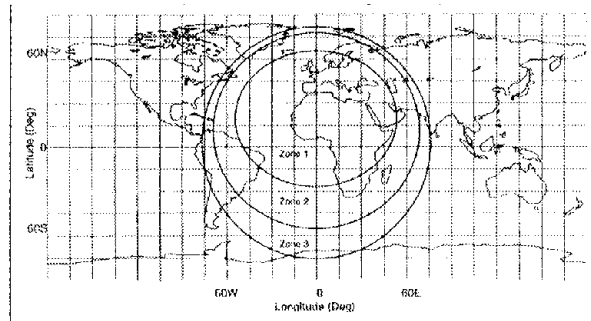
1.4 km (HRV)



4.8 km (others)



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- Zone 1** Central Zone: includes a large part of central and southern Europe
- Zone 2** Nominal Zone: Includes all the Eumetsat member states, most of Africa  
and  
locations at which the elevation to the satellite is greater than or equal to 10 degrees
- Zone 3** Global Zone: includes all locations in the field of view of the satellite, normally where the elevation to the satellite is greater than or equal to 5 degrees. This

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